INDIANA DEPARTMENT OF TRANSPORTATION

INTER-DEPARTMENT COMMUNICATION

Standards Section-Room N642

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DESIGN MEMORANDUM No. 00-12
TECHNICAL ADVISORY

TO: **All Design, Operations, District Personnel and Consultants**

FROM: ***/s/ Anthony L. Uremovich***
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SUBJECT: **Guardrail Over Large Drainage Structures**

EFFECTIVE: **January 17, 2001 Letting**

I. INTRODUCTION

Large drainage structures are defined as those with clear spans of at least 1675 mm, as measured parallel to the roadway centerline, and three-sided culverts. For such structure ends within the clear zone which are costly to extend and whose end sections cannot be made traversable, shielding with guardrail may be provided to protect errant motorists from colliding with a structure end. If the structure end is outside the clear zone, the designer should use engineering judgement to determine if it is desirable to protect the errant motorist from the structure end with guardrail.

If there is inadequate cover over the structure to support the guardrail posts, it will be necessary to use the details for guardrail installations over low-fill structures as shown in the INDOT Recurring Plan Details. In such situations, full embedment of the guardrail posts is often impractical. The designer should also show on the plans where the various types of standard or modified posts are to be used.

In certain situations, steel or concrete bridge railing in accordance with NCHRP 350 criteria also may be required over low-fill structures where modified guardrail posts cannot be utilized. An appropriate guardrail to bridge railing transition should be used.

II. DESIGN PROCEDURE

Determine the length of need for guardrail in advance of the structure or area of concern as required by Design Manual Section 49-5.02. If nested W-beam guardrail is used over the structure and is not sufficient for the calculated length of need, provide additional standard W-beam guardrail to satisfy the length-of-need requirements preceding the nested W-beam guardrail installation as shown in the INDOT Recurrin*g* Plan Details. Likewise, if there is a need for a standard W-beam guardrail beyond the nested W-beam guardrail installation, the standard W-beam guardrail (minimum length 7.62 m) should be connected to the outgoing end of the nested W-beam guardrail installation in lieu of the cable terminal anchor system.

On all projects including 3R, where W-beam guardrail is used to shield a structure, the following procedure should be used for the various combinations of overall structure width (W, mm), and depth of cover (C, mm) over the structure. The overall structure width of a large drainage structure is defined as the width out to out of structure parallel to the roadway centerline for skewed or perpendicular structures.

A. Longitudinal Placement of Guardrail over Large Drainage Structures

1. $W \leq 7400$ and $C < 1250$. Use nested guardrail including a 7620 mm span over the structure as shown in the INDOT Recurring Plan Details.

2. $7400 < W \leq 18600$ and $500 \leq C < 1250$. Use nested guardrail including a 7620 mm span over the structure, and modified posts for the nested guardrail adjacent to the 7620 mm span as shown in the INDOT Recurring Plan Details. The modified posts should be inserted into steel tubes, which are embedded into concrete bases. The concrete post bases should not be attached to the structure. The modified posts with concrete bases should only be used over the structure.

3. W = Any Structure Width and $1250 \leq C < 1550$. Use standard W-beam guardrail with 1830 mm length posts at 1905 mm spacing over the structure, and 2130 mm length posts at 1905 mm spacing preceding and beyond the structure.

4. W = Any Structure Width and $C \geq 1550$. Use standard W-beam guardrail with 2130 mm length posts at 1905 mm spacing.

B. Lateral Guardrail Placement for Large Drainage Structures on Projects on New Alignments Excluding 3R Projects

For these projects it is desirable to perpetuate as much of the clear zone as practical through a structure location. Where sufficient right of way will be acquired to provide the required clear zone, the guardrail systems as described in **II A** above may be installed near the clear zone limits to shield the structure ends which are located within the clear zone, thus, maintaining most of the clear zone required over the structure. However, where these guardrail systems are utilized near the edge of the clear zone, these systems

should not be connected to any other existing or proposed guardrail that is located nearer to the pavement.

C. Lateral Guardrail Placement for Large Drainage Structures on Projects on Existing Alignments and 3R Projects on New Alignments

Many of these projects may not have sufficient right of way to perpetuate the clear zone through the structure location. In these situations, the guardrail should be installed at an offset of up to 0.6 m from the edge of shoulder. These situations will require standard or nested W-beam guardrail depending on the depth of cover available over the structure.

D. Bridge Railing Over Structures With W > 7400 and C <500

If the structure has insufficient cover and the clear span is greater than 7400 mm, it may be cost effective to provide a bridge railing over the opening. However, this design requires an appropriate transition from W-beam guardrail to the bridge railing, thereby increasing the installation cost. A special bridge railing design will be required to accommodate specific site conditions. The lateral placement considerations described in B above apply to the bridge railing also.

E. Cable Terminal Anchor System

The cable terminal anchor system may be used at the outgoing end of any W-beam guardrail run that is not exposed to oncoming traffic. It may be used as the equivalent of the W-beam anchorage guardrail ordinarily required 7.62 m (25 lft) beyond the length of need, where space limitations do not permit placement of such a guardrail run.

F. Grading Requirements for Large Drainage Structures

Grading requirements for structures for rural divided highways on new alignment with a design speed of 110 km/h are shown in the INDOT Recurring Plan Details. For other design speeds, similar grading configurations should be designed using appropriate design criteria and dimensions.

Grading requirements for structures for highways on existing alignment with any design speed are also shown in the INDOT Standard Drawings for grading requirements at guardrail end treatments.

Guardrail length of need should be based on the project clear zone.

III. CONTRACT DOCUMENT REQUIREMENTS

1. Plans. The location and limits of W-beam guardrail and W-beam nested, guardrail, guardrail end treatments and corresponding grading requirements must be shown on all plan and profile sheets and construction detail sheets, where applicable. This information is necessary to inform the contractor where the W-beam guardrail and guardrail end treatments included in the Schedule of Pay

Items are to be installed. In addition, the location of guardrail transitions and W-beam guardrail used to shield an errant motorist from areas of concern must be shown on the appropriate sheets. The designer should also detail in the plans where the various types of standard or modified posts are to be used.

2. Recurring Plan Details and Standard Drawings. The designer must review all Recurring Plan Details and Standard Drawings pertaining to guardrail over structures to determine which drawings are to be included in the contract- specific Recurring Plan Details and Standard Drawings indices.

At least the following Recurring Plan Details and Standard Drawings should be included for the various combination of the drainage structure width (**W, mm**) and **depth of cover (C, mm) as shown below:**

a. W £ 7400 and C < 1250
Recurring Plan Details 601-R-386d 1 through 9 and Standard Drawings 601-GRET-06 through 09.

b. 7400 < W £ 18600 and 500 £ C < 1250
Recurring Plan Details 601-R-386d 1 through 10 and Standard Drawings 601-GRET-06 through 09.

c. W = any structure width and 1250 £ C < 1550
Recurring Plan Details 601-R-386d 7 and 11 and Standard Drawings 601-GRET-06 through 09.

d. W = any structure width and C ³ 1550
Recurring Plan Details 601-R-386d 7 and 11 and Standard Drawings 601-GRET-06 through 09.

3. Specifications/Special Provisions. The Supplemental Specifications, beginning with the September 1, 2001 edition, have incorporated this concept change. Until such time, recurring special provision 601-R-386 and Recurring Plan Details 601-R-386d 1 through 11, as applicable, should be included in the contract documents. Copies are attached. Therefore, for typical situations, the Supplemental Specifications should be sufficient to permit the installation of new permanent W-beam guardrail at large drainage structures. However, the specifications must be reviewed to verify that they are adequate to provide for the installation of all unique W-beam guardrail at structures in the contract. If necessary, special provisions must be written to incorporate contract specific requirements for all unique W-beam guardrail at the structures.

4. Schedule of Pay Items. The new code numbers, pay items, and pay units are as follows:

The pay item for nested **30.48 m** W-beam guardrail with the **7620 mm** span is **601-06854 Guardrail, W-Beam, Nested, EACH.**

The pay item for cable terminal anchor is 601-06855 Guardrail, W-Beam, Cable Terminal Anchor, EACH.

The pay item for modified posts for nested W-beam guardrail is **601-06856 Modified Posts, Nested Guardrail, EACH**.

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